

## COMMENTS

## Comments on the article of “Agriculture Green Development: a model for China and the world”

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The coming century will be one of grand global challenges. We will be facing global warming, a growing world population and growing economies. To meet the needs of all world citizens in a sustainable way will not be easy. One of the challenges will be to feed the growing world population, while limiting global warming. Food and water security are at risk, and we will need to invest in innovative and clean technologies to ensure that also in the future there will be enough food to feed the world. This all is reflected in the UN Sustainable Development Goals.

As one of the largest countries, China will make an important contribution to the future sustainability of our planet. Already, China produces 25% of world's grain and feeds 20% of world's population. However, the agricultural sector is not always efficient in terms of resource use, and can be a polluting sector. This is not only the case in China, but in many other world regions as well. Improving the sustainability of food production is, therefore, an important issue worldwide.

In this issue, Shen et al. (<https://doi.org/10.15302/J-FASE-2019300>) present a novel framework for realizing Agriculture Green Development (AGD). The overall objective of AGD is to combine “green” with “development”. AGD aims to realize a transformation of current agriculture with high resource consumption and high environmental costs towards a green agriculture and countryside with high productivity, high resource use efficiency and low environmental impact. The AGD framework integrates knowledge about (1) the natural system, (2) the food system, and (3) human and social systems.

Shen et al. convincingly call for interdisciplinary innovations, whole food chain improvement and regional solutions. For this, an integrative approach is needed in four key areas.

First, AGD aims for green crop production. Current crop production in China is not always efficient in terms of the use of resources. As a result, the losses of nutrients and other chemicals to the environment are relatively high. Moreover, water demand for irrigation is high. There is a large potential to increase the efficiency of nutrients, chemicals, energy and water in Chinese crop production while maintaining, or even increasing the yields.

Second, AGD aims to integrate crop and animal production. Current developments in China are that crop and animal production are not always well integrated. Large scale animal production systems exist, producing large amounts of animal products and animal waste. In the past, animal manure was used as a fertilizer. Today, however, this is not always the case. As a result, nutrients in the manure may be lost to the environment and not used to fertilize crop lands. Integrating modern crop and animal farming systems will greatly improve the sustainability of Chinese food production.

Third, AGD calls for more sustainable food producing industries. A supply chain approach is needed, to reduce the life-cycle environmental burden of food products. Along the supply chain there are many quick wins, and potentials for large scale innovations.

Fourth, it is important to consider the rural environment and ecosystem services when aiming at AGD. Environmental quality is an important issue. Setting targets for water, air and soil quality is important, and AGD may help to reach these targets. New designs for food chains and effective solutions of whole food system challenges are

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crucial for regional realization of AGD.

With this AGD approach, China may serve as an example. The innovations for good practice are relevant for many other countries in Southeast Asia and Africa with many small-household farmers. Thus the Chinese AGD program has a potential to contribute to global sustainable development strategies.

Likewise, China may learn from other countries with food production systems that are currently more efficient or more integrated than current practice in China.

The strength of the AGD framework as presented by Shen et al. lies in the call for transdisciplinarity. It is essential to integrate knowledge from the natural and social sciences in environmental assessments. However, when searching for truly sustainable futures, we need to also involve stakeholders, to coproduce knowledge about sustainable food production for the future of our planet. This is exactly what Shen et al. propose.

A strength of the AGD approach is the integration in scientific research (excellent research), the training of a new generation of scientists (the CSC program to train PhD students) and the impact on society through the science-technology backyard system (STBs). In these STBs farmers and students learn together how to bring the theory of AGD into the practice of farming. This combination of scientific excellence and science for impact gives AGD its potential to be a highly impactful program.

How to ensure food security and water security for the future generation on our planet, while limiting global warming to 1.5°C and maintaining our biodiversity is the grand challenge for the coming decades. We have about one generation to realize this future. To meet the UN Sustainable Development Goals, requires a circular, highly efficient economy, that does not rely on fossil sources of energy, nutrients and water. That is the challenge for the future of our planet. The AGD framework as described by Shen et al. will make an important contribution to such a sustainable future.